

REMARKS

Claims 1-96 were pending in the Application prior to the amendments herein.

Claims 1-36 and 63-93 are withdrawn from consideration and cancelled without prejudice.

Claims 37-62 and 94-96 are rejected.

Claims 47 and 53 are amended herein. The amendment to Claim 53 is to correct a typographical error, *i.e.* to add a period at the end of the claim.

Claims 37-62 and 94-96 are pending after entry of the amendments herein.

1. **Rejection under 35 U.S.C. § 112, ¶ 1**

The Examiner has rejected Claims 37-62 and 94-96 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Office Action at 2. The Examiner contends that “[t]he claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time of the application was filed, had possession of the claimed invention.” *Id.* The Examiner further contends that “[t]here is no support for the claimed cross-section size, nor of a ‘particulate’. The structure of claim 42 is not supported. It appears that a loose mass of nanotubes is produced.” *Id.*

Applicant respectfully traverses the rejection.

Support for **Claim 37** is taught multiple times in the Application, for example, as cited below.

One embodiment is a carbon nanotube particulate that comprises a plurality of small-diameter carbon nanotubes arranged in a 3-dimensional network in the carbon nanotube particulate. The carbon nanotube particulate has a cross-

sectional dimension of less than about 1000 microns and the small-diameter carbon nanotubes have a diameter in the range of about 0.5 nm and about 3 nm.

Application at 4, *ll.* 25-30.

Support for **Claim 42** is also taught multiple times in the Application, for example, as cited below.

Carbon nanotubes can span between the carbon nanotube particulates.

Application at 6, *ll.* 10-11.

Figure 4A is a transmission electron micrograph (TEM) and **Figure 4B** is a SEM. Both micrographs show the nanotube particulate material and ropes of carbon nanotubes spanning between nanotube particulates.

Application at 8, *ll.* 25-28.

Support for '**particulate**' is taught multiple times in the Application, for example, as cited below.

The carbon nanotube particulates can be a 3-dimensional network of intertwined and interconnected carbon nanotubes, wherein the particulates have a macroscopic particulate morphology with a cross-sectional dimension of less than about 1000 microns.

Application at page 4, *l.* 30 to page 5, *l.* 2.

Support for a '**particulate**' of carbon nanotubes is also found in the descriptions of Figures 1, 2, and 3.

Figures 1A and **1B** are scanning electron micrographs (SEMs) of one embodiment of the present invention at 500X magnification. **Figure 1A** shows the catalyst incorporating carbon nanotubes after it has been subjected to the growth process described in Example 1. **Figure 1B** shows the carbon nanotube product of the growth process after purification by acid treatment as described in Example 1. Comparison of Figures 1A and 1B shows that the morphology of the support is retained in the purified nanotube material and shows the particulate nature of the invention.

Figures 2A and **2B** are SEMs of one embodiment of the present invention at 5000X magnification.

Figure 2A shows the carbon nanotubes on the catalyst support after the nanotubes were grown according to procedures described in Example 1.

Figure 2B shows the carbon nanotube product of the present invention after purification by acid treatment as described in Example 1. Comparison of **Figures 2A and 2B** shows that the morphological form of the support is retained in the purified nanotube material.

Figure 3 is a SEM of the carbon nanotube material at 25,000X magnification after purification according to the procedure given in Example 1. Figure 3 shows the density of carbon nanotube ropes on the particulate surface. The image indicates that the population density of carbon nanotubes exceeds 10 per square micron.

Application at page 8, *ll.* 4-22.

Support for “particulate” is also given in Figures 1 and 2, which are SEM micrographs of exemplary carbon nanotube particulates at magnifications of 500X and 5000X, respectively. At these magnifications, the form and topography of the exemplary particulate can be seen. Figures 1 and 2 are at magnifications which show the topography of the irregularly shaped exemplary particulates, but are too low to see the individual nanotubes or ropes of the particulates. At higher magnification, such as at 25,000X, as shown in Figure 3 and cited above, the individual carbon nanotubes and carbon nanotube ropes of the exemplary particulate are clearly visible.

Applicant respectfully asserts that the claimed subject matter is described in the specification in such a way as to reasonably convey that the inventors were in possession of the claimed subject matter and respectfully requests the Examiner withdraw his rejection of Claims 37-62 and 94-96 under 35 U.S.C. § 112, first paragraph.

2. Rejections under 35 U.S.C. § 102(e)/103(a) over Li

The Examiner has rejected Claims 37-51 and 94-96 under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Li et al., U.S. Patent 7,157,068 (“Li”). Office Action at 3.

Applicant respectfully traverses the rejections.

Anticipation under 35 U.S.C. § 102 requires each and every element of the claim to be found within the cited prior art reference. Regarding rejections under 35 U.S.C. § 103(a), the PTO must make written findings of fact concerning the state of the art and the teachings of the references applied. Furthermore, the PTO must provide articulated reasoning with a rational underpinning to support the legal conclusion of obviousness. Examination Guidelines for Determining Obviousness under 35 U.S.C. 103 in View of the Supreme Court Decision in *KSR International Co. v. Teleflex Inc.*, 72 Federal Register 57526, 57527-28 (October 10, 2007.)

The Examiner stated, “Li teaches in col. 7 and throughout making loose nanotubes.” *Id.* Li teaches a method for making various morphologies of carbon nanotubes. Li teaches the production of linear and branched carbon nanotubes with different tubule morphologies, such as cylindrical hollow SWNT and MWNT, conically-overlapping or “bamboo-like” tubule structures, and branched or “Y-shaped” tubule structures. (Column 3, lines 5-15.) Li does not teach or suggest a carbon nanotube particulate, as required by Claim 37, which is directed to a “carbon nanotube particulate comprising a plurality of small-diameter carbon nanotubes arranged in a 3-dimensional network in the carbon nanotube particulate, wherein the carbon nanotube particulate has a cross-sectional dimension of less than about 1000 microns and wherein the small-diameter carbon nanotubes have a diameter in the range of about 0.5 nm and about 3 nm.” As discussed above, examples of such carbon nanotube particulates are shown in the present

application in Figures 1, 2 and 3. As discussed above, Figure 3, a SEM micrograph at a magnification of 25,000X, clearly shows the individual nanotubes and nanotube ropes that make up the particulate. The 3-dimensional network of carbon nanotubes has the shape of a particulate.

Li does not teach or suggest this arrangement of nanotubes or any such carbon nanotube particulate. There is nothing in *Li* that teaches or suggests a discrete carbon nanotube particulate comprising carbon nanotubes in a 3-dimensional network. There is also no teaching or suggestion in *Li* to modify the products disclosed therein in order to arrive at the elements of the present invention.

The Examiner further contends that “[t]he diameters can be the same as claimed, even though none are exemplified by the reference. No difference is seen in the product; the overlapping size range renders the claims unpatentable.” *Id.*

Applicant respectfully traverses the Examiner’s contention. *Li* teaches production of different morphologies of carbon nanotubes. *Li* does not teach or suggest any carbon nanotube particulate, such as one having the elements required of Claim 37 and claims depending therefrom. As *Li* does not teach or suggest a carbon nanotube particulate, so also, *Li* does not teach or suggest a diameter for such a particulate. Therefore, Claim 37 is neither anticipated nor obvious over *Li*.

Claims 38-51 are directly or indirectly dependent upon Claim 37 and are not anticipated or obvious over *Li* for the same reasons.

The Examiner further contends that Claim 47 is a process step which does not limit the product. Office Action at 3. Applicant has amended this claim to delete the process step. In any event, this claim depends on Claim 37 and is therefore patentable for the same reasons.

Claim 94 requires, *inter alia*, forming “carbon nanotube particulates, wherein the carbon nanotube particulates retain a macroscopic morphology of an approximate shape and an approximate cross-sectional dimension as before removal of the particulate support.” As stated above, *Li* does not teach or suggest making any carbon nanotube particulate, let alone a carbon nanotube particulate wherein the carbon nanotube particulate retains a macroscopic morphology of an approximate shape and an approximate cross-sectional dimension as before removal of the particulate support. Furthermore, there is no apparent reason that one of ordinary skill in the art would modify the teachings of *Li* in order to achieve all the elements of Claim 94. Therefore, Claim 94 is not anticipated or obvious over *Li*.

Claims 95-96 are dependent upon Claim 94, and are not anticipated or obvious over *Li* for the same reasons.

Therefore, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 37-51 and 94-96 under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over *Li*.

3. Rejections under 35 U.S.C. § 103(a) over Li with Applicants’ Alleged Admissions

The Examiner has rejected Claims 37-54 and 94-96 under 35 U.S.C. § 103(a) as obvious over *Li* taken with applicants’ admissions. Office Action at 3.

Applicant respectfully traverses the rejections.

The Examiner contends that “*Li* does not teach polymers, however applicants admit that compound[ing] them is well known to make useful materials. Using the nanotubes of *Li* in such composites is an obvious expedient to exploit their mechanical and electrical properties.” *Id*.

In the first place, the Examiner has not given a page and line number reference to the alleged “admission” by applicant. Without such a specific reference, and given the vague discussion of the alleged “admission” by the Examiner in the office action, applicant is unable to respond in more detail on this point. However, there is certainly nothing in the present application that would constitute an admission indicating the claimed invention is obvious.

As noted above, *Li* does not teach or suggest a carbon nanotube particulate which requires, *inter alia*, a “carbon nanotube particulate comprising a plurality of small-diameter carbon nanotubes arranged in a 3-dimensional network in the carbon nanotube particulate, wherein the carbon nanotube particulate has a cross-sectional dimension of less than about 1000 microns” Furthermore, there is no apparent reason that one of ordinary skill in the art would modify the teachings of *Li* in order to achieve all the elements required by Claim 37. Therefore, Claim 37 is not obvious.

Claims 38-54 are dependent, either directly or indirectly, upon Claim 37 and are not obvious for the same reasons.

Claims 94-96 differ from *Li* as discussed above.

Therefore, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 37-54 and 94-96 under 35 U.S.C. § 103(a) as obvious over *Li* taken with the Applicants’ alleged admissions.

4. Rejections under 35 U.S.C. § 103(a) over Li with Applicants’ Alleged Admissions and Dresselhaus

The Examiner has rejected Claims 55-60 under 35 U.S.C. § 103(a) as obvious over *Li* taken with applicants’ alleged admissions and Dresselhaus, et al., “Carbon Nanotubes: Synthesis, Structure, Properties and Applications,” Springer-Verlag, Berlin Heidelberg XP002273341, page

32, paragraph 1.2 - page 39; page 394, paragraph 1 - page 401; page 406, paragraph 3-page 412 (2001) ("*Dresselhaus*"). Office Action at 3.

Applicant respectfully traverses the rejections.

The Examiner contends that "*Li* do [sic] teach not derivatized nanotubes, however *Dresselhaus* teaches on pg. 408-410 derivatization to improve compounding. Derivatizing the nanotubes of *Li* is an obvious expedient to make them easier to form composites." *Id.*

Claims 55-60 depend, directly or indirectly, upon independent Claim 37. As noted above, *Li* does not teach or suggest a carbon nanotube particulate, as required by Claim 37. Claims 55-60 are not obvious for the same reasons.

Therefore, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 55-60 under 35 U.S.C. § 103(a) as obvious over *Li* taken with the Applicants' alleged admissions and *Dresselhaus*.

5. Rejections under 35 U.S.C. § 102(a)/103(a) over Resasco

The Examiner has rejected Claims 37-51, 61, 62 and 94-96 under 35 U.S.C. § 102(a) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Resasco et al., U.S. Patent 6,333,016 ("*Resasco*"). Office Action at 3.

Applicant respectfully traverses the rejections.

The Examiner contends that "*Resasco* teaches in col. 1, 6, 8 making carbon nanotubes which can be the claimed size. Also taught is use as an emitter. As above, no differences are seen in the product." *Id.*

Resasco does not teach or suggest a carbon nanotube particulate, as required by Claim 37. Therefore, *Resasco* does not teach or suggest each element of Claim 37. Furthermore, there is no

apparent reason that one of ordinary skill in the art would modify the teachings of *Resasco* in order to achieve all the elements of the present invention. Therefore, Claim 37 is not anticipated or obvious over *Resasco*.

Regarding Claims 61 and 62, *Resasco* makes a general statement regarding carbon nanotubes and field emission in “A Brief Description of the Prior Art,” cited below.

Carbon nanotubes have shown promising applications including nanoscale electronic devices, high strength materials, electron field emission, tips for scanning probe microscopy, and gas storage.

(*Resasco* at Col. 1, *ll.* 29-32)

This statement does not provide guidance to one of ordinary skill as to the specific structure as required by Claims 61 and 62, which depend on Claim 37.

Claims 38-51, 61 and 62 are directly or indirectly dependent upon Claim 37 and are not anticipated or obvious over *Resasco* for the same reasons Claim 37 is not anticipated or obvious.

As discussed above, Claim 94 requires, *inter alia*, forming “carbon nanotube particulates, wherein the carbon nanotube particulates retain a macroscopic morphology of an approximate shape and an approximate cross-sectional dimension as before removal of the particulate support.” *Resasco* does not teach or suggest making a carbon nanotube particulate, let alone a carbon nanotube particulate wherein the carbon nanotube particulates retain a macroscopic morphology of an approximate shape and an approximate cross-sectional dimension as before removal of the particulate support. Furthermore, there is no apparent reason that one of ordinary skill in the art would modify the teachings of *Resasco* in order to achieve all the elements of Claim 94. Therefore, Claim 94 is not anticipated or obvious over *Resasco*.

Claims 95-96 depend upon Claim 94, and are not anticipated or obvious over *Resasco* for the same reasons.

Therefore, Applicant respectfully requests that the Examiner withdraw his rejection of 37-51, 61, 62 and 94-96 under 35 U.S.C. § 102(a) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over *Resasco*.

6. Additional Comments in Office Action

On page 4 of the office action, the Examiner stated that the IDS's filed in this application lack references to Smalley. Applicant has listed in the IDS's the references that were considered appropriate to list under the applicable rules. If the Examiner thinks that additional references are pertinent, he is free to cite them in an office action. Applicant notes that the Examiner also stated in the office action "The references cited are of interest [applicant understands this to mean certain Smalley references that the Examiner has in mind], but not applied to avoid duplication of rejection." In view of this admission by the Examiner that the unnamed Smalley references are cumulative to the references already cited by applicant, it appears that nothing more needs to be done in this regard. If the Examiner has a different view, applicant respectfully requests that he state it explicitly on the record, and identify the specific Smalley references that he has in mind.

The Examiner also included on page 4 of the office action the following statement: "Also, the question of common ownership with Smalley/Rice University at the time of the invention should be addressed." The inventors of this application have assigned it to Carbon Nanotechnologies, Inc., and the assignment has been recorded in the PTO at reel 15235, frame 118. Applicant is not aware of any reason why Dr. Smalley or Rice University would be owners

of this patent application. If the Examiner is aware of any such facts, applicant respectfully suggests he should explicitly state them in the record, so applicant can respond appropriately. If the Examiner is not aware of any such facts, then applicant cannot understand why the Examiner would make such a statement. Applicant respectfully requests clarification.

7. Conclusion

Applicant respectfully contends that claims 37-62 and 94-96, as amended and presented herein, are now in condition for allowance.

The Examiner is invited to contact the undersigned attorney at (713) 934-4094 with any questions, comments or suggestions relating to the referenced patent application.

Respectfully submitted,

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